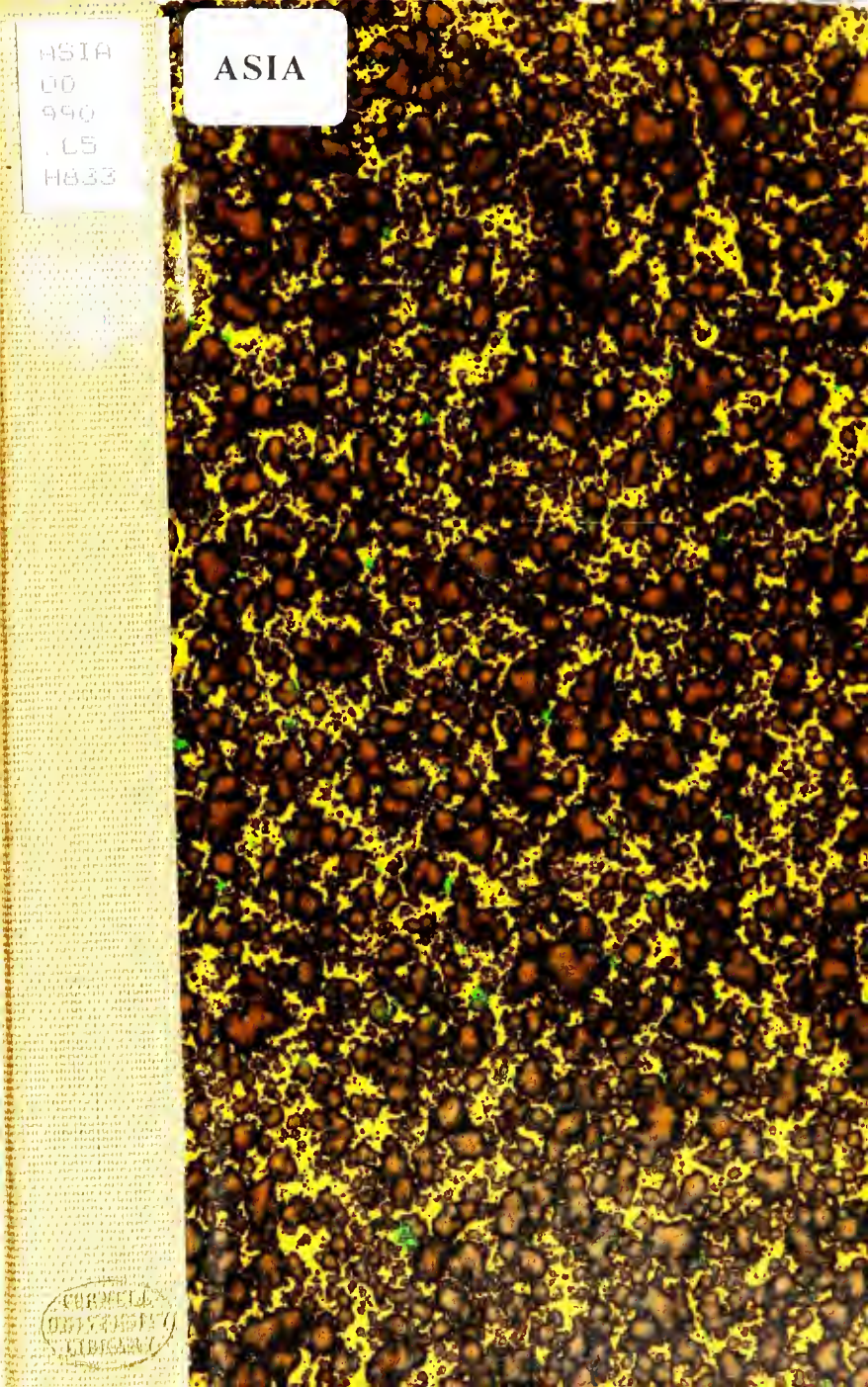
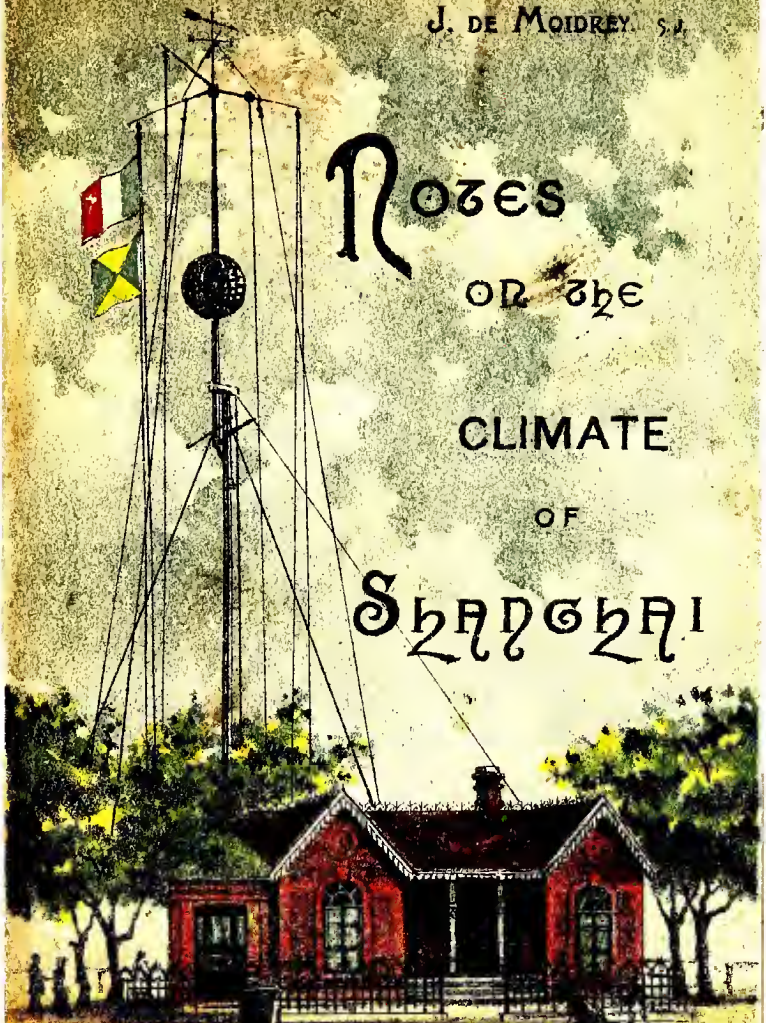
ASIA



J. DE MOIDREY. S.J.

NOTES ON THE CLIMATE OF SHANGHAI



SICAWEI OBSERVATORY

LITHO. ORIENTAL PRESS.

SICAWEI OBSERVATORY

J. DE MOIDREY, S. J.

NOTES

ON THE

CLIMATE OF SHANGHAI

1873 - 1902

SHANGHAI
ORIENTAL PRESS
1904

SOLD BY KELLY & WALSH, SHANGHAI

NOTES ON THE CLIMATE

OF SHANGHAI

The following pages contain no technical research : the wish of the compiler is merely to put into the hands of English speaking Shanghai residents a few results, which it is hoped may prove useful to the general public.

The *notes* are an enlarged translation of an appendix to the "Calendrier-annuaire pour 1904," which already appeared in French.

The measures used are of course international, but the equivalent in British units is invariably given together with the metrical, and placed between brackets or in a separate column.

§I.—TEMPERATURE

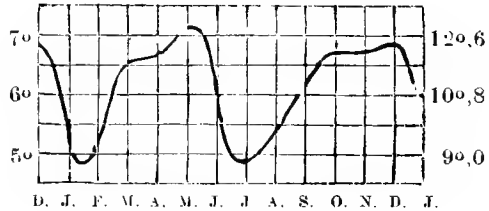
A satisfactory exposure of the thermometer is not easily found. To give the temperature of the air, the instrument must be sheltered from the sun and from the reflected heat of neighbouring objects, be in a place where air circulates freely, and removed from walls or any other bodies the temperature of which may differ from that of the air perhaps by several degrees.

The best means of obtaining the temperature of the air consists in the *sling* thermometer. Tie a string to the top of the instrument, place yourself in the open air, preferably facing the wind, and if possible in the shade, then swing the thermometer briskly around your head for a minute or so, and read it off quickly so that the heat of your body has been unable to influence the mercury.

TIME —If the temperature is taken once a day, this should always be at the same hour, say about 9 a.m. If you can take it twice a day, let one observation be made shortly after sunrise, this will give you very nearly the minimum of the day; the other, if about 2 p.m., will show the maximum or very nearly so. The mean (half the sum) of these two will differ very little from the mean temperature of the day, as given by 24 hourly readings.

DAILY RANGE. — Every day, except under abnormal circumstances, the lowest temperature takes place shortly after sunrise. It rises then until about 2 p.m., then falls again until the next morning. The difference or range between the coldest and warmest temperature, which is of paramount importance for hygiene, varies considerably with seasons, latitude, altitude and many other circumstances.

The following table gives, for each of the twelve months, the mean daily variation of the temperature of the air at Sicawei. It is given twice, in centigrade and Fahrenheit units. The last line contains the mean daily range, that is the change we daily experience. It will be seen that this feature, which is of considerable importance, has also a regular variation which is exhibited on the little diagram. The difference between the early hours and midday is greater in March, April, May, — October, November and December and smaller in January, February, March. — June, July and August, that is during the coldest and warmest months.



Daily range

On the plate, which represents the daily variation, the distance between two lines is 2° C (3°, 6 F). A dot marks the hour of sunrise and sunset.

Diurnal Variation of the Temperature

(17 YEARS OF OBSERVATION)

I.—CENTIGRADE THERMOMETER

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Midn.	1°,2	2°,5	6°,2	11°,2	16°,0	20°,5	24°,7	24°,5	20°,6	15°,4	8°,9	3°,5
1h	1,1	2,3	6,0	11,0	15,8	20,4	24,6	24,3	20,4	15,1	8,6	3,3
2	0,9	2,1	5,7	10,9	15,7	20,2	24,5	24,2	20,3	15,0	8,5	3,1
3	0,8	1,9	5,5	10,6	15,5	20,1	24,4	24,0	20,1	14,9	8,3	2,9
4	0,7	1,8	5,5	10,5	15,4	20,0	24,3	23,9	20,0	14,8	8,2	2,8
5	0,5	1,7	5,4	*10,4*	*15,2*	*1,99*	*24,2*	*23,8*	*19,9*	*14,7*	8,1	2,6
6	0,5	*1,6*	*5,3*	10,6	15,9	20,5	24,7	24,2	20,2	14,8	*8,0*	*2,5*
7	*0,4*	1,7	5,8	11,8	17,3	21,5	25,5	25,5	21,3	15,6	8,2	*2,5*
8	1,1	2,6	7,3	13,3	18,8	22,5	26,5	26,6	23,0	17,6	10,2	3,7
9	2,7	3,8	8,8	14,5	19,8	23,4	27,3	27,5	21,1	19 2	12,1	5,7
10	4,1	5,1	9,9	15,5	20,8	24,1	28,0	28,2	24,9	20,3	13,5	7,5
11	4,9	5,9	10,8	16,3	21,7	24,6	28,5	28,7	25,5	21,0	14,2	8,4
Noon	5,6	6,4	11,4	16,8	22,0	25,0	28,9	29,0	25,6	21,3	**14,5**	9,0
1h	**5,9**	6,7	11,7	17,0	**22,3**	25,2	**29,1**	**29,2**	**26,1**	**21,4**	**14,7**	9,2
2	**5,9**	**6,8**	**11,8**	**17,1**	**22,3**	**25,9**	**29,1**	**29,2**	25,6	21,3	**14,7**	**9,3**
3	5,7	6,6	11,5	16,8	22,1	25,2	**28,8**	29,0	25,2	20,9	14,4	9,0
4	5,3	6,2	11,1	16,3	21,6	24,8	28,3	28,4	24,7	20,3	13,7	8,4
5	4,3	5,5	10,2	15,4	20,7	24,2	27,7	27,7	23,8	19,0	12,4	7,1
6	3,3	4,6	9,1	14,3	19,5	23,4	27,0	26,9	22,7	17,7	11,2	6,0
7	2,7	4,0	8,1	13,1	18,2	22,3	26,2	25.8	21,9	16,9	10,5	5,3
8	2,3	3,5	7,5	12,5	17,5	21,7	25,7	25,3	21,4	16,4	9,9	4,7
9	1,9	3,2	7,1	12,0	16,9	21,3	25,3	24,9	21,3	16,0	9,6	4,4
10	1,7	3,0	6,7	11,7	16,6	21,1	25,1	24,8	21,1	15,7	9,3	4,0
11	1,4	2,8	6,5	11,5	16,4	20,8	24,9	24,6	20,9	15,5	9,0	3,7
Range	5,5	*5.2*	6,5	6,7	**7,1**	6,0	*4,9*	5,4	6,2	6,7	6,7	**6,8**

Diurnal Variation of the Temperature

(17 YEARS OF OBSERVATION)

II.—FAHRENHEIT THERMOMETER

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Midn.	34°,2	36°,4	43°,1	52°,1	60°,8	69°,0	76°,5	76°,0	69°,1	59°,7	47°,9	38°,3
1h	33,9	36,1	42,7	51,8	60,5	68,6	76,2	75,8	68,7	59,3	47,6	37,9
2	33,7	35,8	42,3	51,6	60,2	68,4	76,0	75,5	68,5	59,0	47,3	37,6
3	33,4	35,5	42,0	51,2	60,0	68,2	75,8	75,3	68,2	58,7	47,0	37,3
4	33,2	35,3	41,8	50,9	59,7	68,0	75,7	75,1	68,0	58,6	46,8	37,0
5	33,0	35,1	41,7	*50,8*	*59,4*	*67,9*	*75,6*	*74,9*	*67,9*	*58,5*	46,6	36,7
6	32,8	*35,0*	*41,6*	51,2	60,6	68,9	76,4	75,6	68,3	58,6	*46,4*	36,6
7	*32,7*	35,1	42,5	53,2	63,2	70,7	77,9	78,0	70,4	60,0	46,8	*36,6*
8	34,0	36,7	45,2	55,9	65,8	72,5	79,6	80,0	73,3	63,7	50,3	38,7
9	36,8	38,9	47,8	58,0	67,7	74,0	81,1	81,4	75,3	66,5	53,7	42,3
10	39,3	41,1	49,9	60,0	69,5	75,4	82,4	82,8	76,9	68,6	56,3	45,4
11	40,9	42,6	51,4	61,3	71,0	76,4	83,2	83,7	77,8	69,8	57,6	47,2
Noon	42,0	43,5	52,5	62,2	71,7	77,1	83,9	84,3	78,1	70,4	58,2	48,1
1h	42,5	44,0	53,0	62,7	72,1	77,4	84,3	**84,5**	**79,0**	**70,4**	**58,5**	48,5
2	**42,7**	**44,2**	**53,2**	**62,7**	**72,2**	**78,6**	**84,3**	84,5	78,1	70,4	58,5	**48,7**
3	42,3	43,9	52,8	62,3	71,8	77,3	83,8	84,1	77,3	69,7	57,9	48,2
4	41,5	43,2	51,9	61,4	70,9	76,7	83,0	83,1	76,5	68,5	56,6	47,1
5	39,8	41,9	50,4	59,7	69,2	75,5	82,0	81,9	74,9	66,2	54,3	44,8
6	38,0	40,3	48,3	57,7	67,1	74,1	80,6	80,3	72,9	63,8	52,2	42,8
7	36,9	39,1	46,5	55,6	64,8	72,2	79,2	78,4	71,4	62,3	50,9	41,5
8	36,1	38,4	45,4	54,4	63,4	71,1	78,2	77,5	70,6	61,4	49,9	40,5
9	35,4	37,8	44,7	53,7	62,5	70,4	77,5	76,9	70,3	60,8	49,2	39,9
10	35,0	37,5	44,1	53,1	61,9	69,9	77,1	76,6	69,9	60,3	48,7	39,2
11	34,6	37,0	43,7	52,8	61,5	69,5	76,9	76,2	69,6	59,8	48,1	38,6
Range	10,0	*9,3*	11,6	12,0	**12,7**	10,7	*8,7*	9,6	11,1	12,0	12,1	**12,2**

ANNUAL CHANGE. In the temperate zone, the greatest cold occurs about the middle of January and the hottest days in the middle of July. But this variation is largely affected by geographical and topographical or local conditions. In the neighbourhood of the great oceans, the range is smoothed down, the minimum and maximum both take place later, say in February and August. On the great continents, winters are colder, summers hotter, whilst the date of the lowest and highest temperature is nearer the solstices. Northern China has a *continental* climate.

We now give, for each period of five days, the mean temperature at Sicawei. The figures are the result of 30 years of observation and convey a fair idea of the annual change. It will be seen that the coldest weather occurs about the beginning of February and the warmest about the 1st of August: in each case nearly 40 days after the solstices. See plate, p. 6, curve Z.

Mean temperature at Sicawei

	C.	F.		C.	F.		C.	F.		C.	F.
Jan. 1	3°,29	37°,9	Apr. 1	11°,23	52°,2	July 5	26°,36	79°,4	Oct. 3	19°,80	67°,6
6	2,90	37,2	6	11,84	53,3	10	27,00	80,6	8	19,31	66,8
11	3,52	38,3	11	12,97	55,3	15	27,64	81,8	13	18,06	64,5
16	2,78	37,0	16	13,41	56,1	20	27,62	81,7	18	17,56	63,6
21	2,82	37,1	21	14,90	58,8	25	27,74	81,9	23	15,67	60,2
26	3,18	37,7	26	15,74	60,3	30	**28,29**	**82,9**	28	15,29	59,5
31	*2,59*	*36,7*	May 1	16,30	61,3	Aug. 4	27,86	82,1	Nov. 2	13,69	56,6
Feb. 5	2.73	36,9	6	17,42	63,4	9	27,56	81,6	7	13,42	56,2
10	2,62	36.7	11	18,20	64,8	14	27,52	81,5	12	11,55	52,8
15	4,12	39,4	16	18,64	65,6	19	26,85	80,3	17	11.79	53.2
20	4,91	40,8	21	19,84	67,7	24	26,52	79,7	22	10,14	50,3
25	5.87	42.6	26	20,39	68,7	29	25,78	78,4	27	8,15	46,7
Mar. 2	5,66	42,2	31	21,13	70,0	Sept. 3	24,84	76,7	Dec. 2	7,81	46,2
7	6.80	44,2	June 5	21,59	70,9	8	24,07	75,3	7	6,91	44,5
12	6,77	44,2	10	22 37	72,3	13	22,78	73,0	12	6,28	43,3
17	7,93	46,3	15	23,35	74,0	18	22,14	71,9	17	4,66	40,4
22	8,78	47,8	20	23,90	75,0	23	21,25	70 3	22	4,74	40,5
27	10 33	50,6	25	24,35	75,8	28	20,59	69,1	27	4,27	39,7
			30	25,21	77,4				32	3,29	37,9

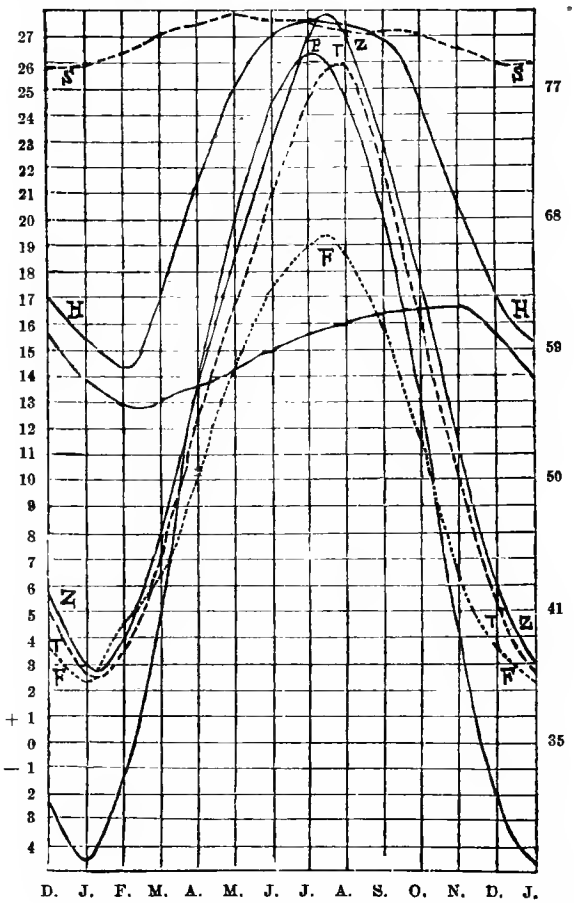
A comparison of the Shanghai yearly variation with that of other climates will render it more easy to realise its peculiarities. We here append the monthly means for 6 stations, which we place in the order of their latitudes.

In the annexed plate, the curves belonging to the China

stations, Peking (P), Sicawei (Z), Hongkong (H) are in full lines, Paris (*F*) and Singapore (*S*) in dotted lines and Tôkyô (*T*) in a mixed line.

The full line in the middle of the diagram represents the temperature of the well, which is sunk in the garden of the old Observatory (p. 10).

Temperature: Annual variation



Comparative temperature

	Paris 49° (60 years)		Peking 40° (31 years)		Tôkyô 35° (25 years)		Sicawei 31° (30 years)		Hongkong 22° (18 years)		Singapore 1° (20 years)	
	C	F.	C.	F.	C.	F.	C.	F.	C.	F,	C.	F.
Jan.	*2,4*	*36,3*	*-4,6*	*23,7*	*2,7*	*36,9*	*3,0*	*37,4*	15,4	59,7	26,0	78,9
Feb.	4,5	40,1	-1,4	29,5	3,6	38,5	4,0	39,2	*14,2*	*57,5*	26,3	79,4
March	6,4	43,5	5,1	41,2	6,8	44,2	7,9	46,2	17,0	62,6	27,0	80,6
April	10,1	50,2	13,8	56,8	12,4	54,3	13,6	56,5	21,2	70,2	27,4	81,3
May	14,2	57,6	19,9	67,8	16,6	61,9	18,6	65,5	24,9	76,8	**7,8**	**8,1**
June	17,2	63,0	24,3	75,7	20,9	69,6	23,0	73,4	27,0	80,5	27,6	81,6
July	**18,9**	**66,0**	**26,1**	**79,0**	24,4	75,9	**27,0**	**80,6**	**27,6**	**81,6**	27,5	81,4
August	18,5	65,3	24,6	76,3	**25,7**	**78,3**	26,8	80,2	27,2	81,0	27,2	81,0
Sept.	15,7	60,3	20,1	68,2	22,0	71,6	22,6	72,7	26,8	80,2	27,1	80,7
October	11,3	52,3	12,5	54,5	15,7	60,3	17,4	63,3	24,3	75,7	26,9	80,5
Nov.	6,5	43,7	3,8	38,8	10,1	50,2	11,1	52,0	20,6	69,1	26,5	79,6
Dec.	3,7	38,7	-2,4	27,7	5,2	41,4	5,6	42,1	17,0	62,5	*25,9*	*78,6*
Year	10,8	51,4	11,8	53,2	13,8	56,8	15,1	59,2	21,9	71,5	26,9	80,4
Range	16,5	29,7	30,7	55,3	23,0	41,4	24,0	43,2	13,4	24,1	1,9	3,5

Extreme temperatures

What we practically experience is not the *mean*, but the actual temperature. Two very different readings, say 24° and 80°, will give the same mean 52° as two others almost identical, v.g. 50° and 54°. It is therefore of much importance to know how much the thermometer departs from the mean.

We consequently give here the normal and abnormal temperatures observed at Sicawei since 1873. The table requires but little explanation.

Take January for instance. The normal monthly mean is 3°,0 (37°,4), but in a cold year (1878) it was as low as —0°,4 (31°,4) and in a warm year (1902) as high as 6°,1 (43°,0). The highest reading in January is ordinarily about

15°,8 (60°,4); however it rose to 21° ,2 (70°,2) on Jan. 5th 1897 and on the contrary in 1876 never reached more than 9° ,3 (48°,7). Again, the greatest cold during that month is regularly—6°,6 (20° ,1), but it happened (1902) not to fall below —2°,7 (27°,1) or to fall as low as—12°,1 (10°,2), this being the greatest cold recorded at the Observatory (January 19th 1893).

If we compare, within each year, from 1873 to 1902, the coldest and warmest month, it is found that the greatest variation of the monthly means was 27°,6 (49°,7) in 1878 and 1893 and the lowest 20°,5 (36°,9) in 1902.

The difference between the highest maximum and the lowest minimum, that is to say the difference we feel in one year, reached its highest value : 50°,1 (90° ,2) in 1893 and its lowest : 41°2 (74° ,2) in 1882.

But from the 15th of August 1892 to the 19th of January 1893, a space of 5 months, a fall of temperature was experienced extending to 51°,5 (92°,7).

Normal and abnormal temperature at Sicawei

(1873–1902)

	MONTHLY MAXIMUM						MONTHLY MEAN						MONTHLY MINIMUM					
	Warm		Average		Cold		Warm		Average		Cold		Warm		Average		Cold	
	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.
Jan.	21,2	70,2	15,8	60,4	0,3	48,7	6,1	43,0	3,0	37,4	−0,4	31,3	−2,7	27,1	−6,6	20,1	−12,1	10,2
Feb.	22,5	72,5	16,8	62,2	10,4	50,7	7,0	44,6	4,0	39,2	1,2	34,2	−1,4	29,5	−5,0	23,0	− 8,4	16,9
Mar.	28,0	82,4	23,4	74,1	16,0	60,8	10,5	50,9	7,9	46,2	5,5	41,9	−0,1	31,8	−1,9	28,6	− 5,9	21,4
Apr.	33,8	92,8	28,9	84,0	24,1	75,4	16,3	61,3	13,0	56,5	11,5	52,7	6,3	43,3	2,5	36,5	− 1,3	29,7
May	35,7	96,3	31,3	88,3	27,6	81,7	20,5	68,9	18,6	65.5	17,2	63,0	12,3	54,1	8,0	46,4	3,0	37,4
June	38,0	100,4	34,8	94,6	31,8	89,2	25,6	78,1	23,0	73,4	21,4	70,5	16,2	61,2	14,1	57,4	10,5	50,9
July	38,9	102,0	36,8	98,2	34,0	93,2	29,2	84,6	27,0	80,6	25,0	77,0	23,0	73,4	19,5	67,1	15,9	60,6
Aug.	39,4	102,9	36,2	97,2	33,1	91,6	28,6	83,5	26,8	80,2	24,7	76,5	22,8	73,0	19,3	66,7	16,1	61,0
Sept	37,7	99,9	33,2	91,8	29,1	84,4	24,2	75,6	22,6	72 7	21,0	69,8	16,9	62,4	13,4	57,9	6,8	44,2
Oct.	32,1	89,8	28,5	83,3	26,3	79,3	19,0	66,2	17,4	63,3	14,9	58,8	10,7	51,3	5,3	41,5	1,1	34,0
Nov.	26,5	79,7	23,2	73,8	20,1	68,2	13,6	56,5	11,1	52,0	8,3	46,9	4,1	39,4	−1,0	30,2	− 4,6	23,7
Dec.	22,7	72,9	18,4	65,1	14,2	57,6	8,7	47,7	5,6	42,1	2,9	37,2	−0,4	31,3	−5,6	21,9	− 9,8	14,4
	Maximum of the year						Yearly mean						Minimum of the year					
	39,4	102,9	37,3	99,1	34,6	94,3	15,8	60,4	15,1	59,2	14,3	57,7	−4,3	24,3	−7,5	18,5	−12,1	10,2

Variability of temperature

Computing the difference between the highest and lowest monthly mean for each month in different years, we obtain the following results.

	Hongkong		Sicawei		Peking	
	C.	F.	C.	F.	C.	F.
January	**5°,2**	**9°,4**	**6°,5**	**11°,7**	5°,8	10°,4
February	**5,2**	**9,4**	5,8	10,4	**8,2**	**14,8**
March	3,2	5,8	5,0	9,0	5,8	10,4
April	2,8	5,0	4,8	8,6	6,0	10,8
May	2,4	4,3	3,3	5,9	4,2	7,6
June	1,6	2,9	4,2	7,6	4,7	8,5
July	*1,0*	*1,8*	4,2	7,6	4,0	7,2
August	1,7	3,1	3,9	7,0	*2,5*	*4,5*
September	1,7	3,1	*3,2*	*5,8*	3,9	7,0
October	2,6	4,7	4,1	7,4	3,8	6,8
November	2,3	4,1	5,3	9,5	6,4	11,5
December	3,7	6,7	5,8	10,4	6,7	12,1

It appears that there is less difference between a same summer month in different years than between a same winter month, also that successive years differ more in the North than in the South. So at Hongkong, the monthly mean for July is always the same between the narrow limits of 1°,0 (1°,8), whilst at Peking the mean for February may vary by 8°,2 (14°,8).

It must be remarked that these temperatures are taken in the shade and in a position allowing very free passage to the air. In other circumstances, the thermometer may rise much higher. For instance a white bulb thermometer placed in vacuo, in full sunshine, over our lawn, rises above 46° (115°) several times every year.

Temperature in Shanghai is somewhat different from that at Sicawei.

Temperature of underground water

Underground waters, even not very deep, have an almost constant temperature. The following are the monthly means for the well of the old Observatory, the depth of which is about 7 metres (23 feet). In a second column is the temperature of the open air.

	Well		Air			Well		Air	
	C.	F.	C.	F.		C.	F.	C.	F.
January	13°,8	56°,8	*3°,0*	*37°,4*	July.....	15°,6	60°,1	**27°,0**	**80°,6**
Feb.....	*13,1*	*55,6*	4,0	39.2	August..	16,0	60,8	26,8	80,2
March ...	*13,1*	*55.6*	7,9	46,2	Sept.....	16,3	61,3	22,6	72,7
April.....	13,6	56,5	13,6	56,5	Oct.....	16,5	61,7	17,4	63,3
May.....	14,3	57.7	18,6	65,5	Nov.....	**16,6**	**61,9**	11,1	52,0
June.....	15,1	59,2	23,0	73,4	Dec.....	15.5	59,9	5,6	42,1
					Mean	14,96	58.93	15,05	59.09

The yearly mean is almost the same, but the range is 7 times smaller in the well, being 3°,5 (6°,3) against (24°,0) (43°,2). It is noteworthy that whilst the minimum occurs about one month after that in the open air, the maximum takes place as late as November. This may be owing to the warm rains in summer, which slowly percolate into the subsoil ; the winter months on the contrary are very dry.

See curve on plate p. 6.

Variation of the climate

Is the climate of Shanghai becoming milder? As this query is susceptible of different meanings according to the different inquirers, we can only offer a few figures which have a bearing upon it and leave to the readers the pleasure of finding out the answer for themselves.

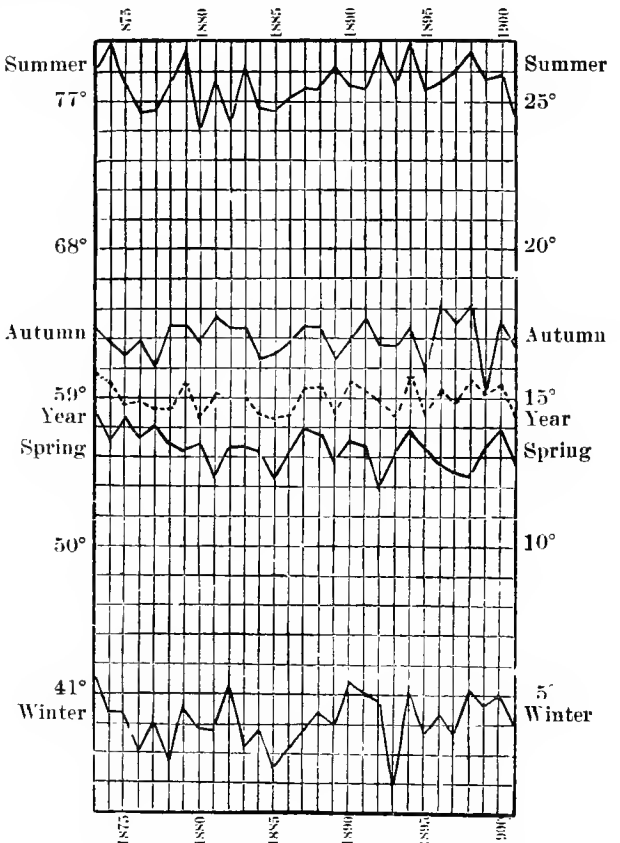
Seasonal means

Winter includes December of the preceding year, January and February.

	Winter		Spring		Summer		Autumn	
	C.	F.	C.	F.	C.	F.	C.	F.
	°	°	°	°	°	°	°	°
1873	**5,6**	**42,1**	**14,6**	**58,3**	26,1	79,0	17,3	63,1
1874	4,4	39,9	13,7	56,7	**26,9**	**80,4**	16,9	62,4
1875	4,4	39,9	14,2	57,6	25,6	78,1	16,5	61,7
1876	3,1	37,6	13,7	56,7	24,7	76,5	16,9	62,4
1877	4,1	39,4	14,1	57,4	24,8	76,6	16,1	61,0
1878	2,8	37,0	13,5	56,3	25,6	78,1	17,4	63,3
1879	4,6	40,3	13,2	55,8	26,7	80,1	17,4	63,3
1880	3,9	39,0	13,5	56,3	*24,0*	*75,2*	16,9	62,4
1881	3,8	38,8	12,3	54,1	25,7	78,3	17,7	63,9
1882	5,3	41,5	13,4	56,1	24,3	75,7	17,4	63,3
1883	3,3	37,9	13,4	56,1	26,1	79,0	17,4	63,3
1884	3,8	38,8	13,2	55,8	24,8	76,6	16,3	61,3
1885	2,6	36,7	12,3	54,1	24,7	76 5	16,5	61,7
1886	3,2	37,8	13,2	55,8	25,1	77,2	16,9	62,4
1887	3,8	38,8	14,0	57,2	25,4	77,7	17,4	63,3
1888	4,4	39,9	13,8	56,8	25,5	77,9	17,4	63,3
1889	4,0	39,2	12,9	55,2	26,1	79,0	16,4	61,5
1890	5,4	41,7	13,6	56,5	25,5	77,9	17,0	62,6
1891	5,1	41,2	13,4	56,1	25,4	77,7	17,7	63,9
1892	4,8	40,6	*12,0*	*53,6*	26,7	80,1	16,8	62,2
1893	*1,9*	35,4	13,3	55,9	25,6	78,1	16,8	62,2
1894	5,1	41,2	13,9	57,0	**26,9**	**80,4**	17,3	63,1
1895	3,8	38,8	13,4	56,1	25,4	77,7	15,9	60,6
1896	4,3	39,7	12,8	55,0	25,7	78,3	**18,1**	**64.6**
1897	3,8	38,8	12,5	54,5	26,0	78,8	17,6	63,7
1898	5,2	41,4	12,4	54,3	26,7	80,1	**18,1**	**64.6**
1899	4,7	40,5	13,4	56,1	25,8	78,4	*15,3*	*59,5*
1900	5,0	41,0	13,9	57,0	26,0	78,8	17,5	63,5
1901	4,1	39,4	12,9	55,2	24,6	76,3	16,9	62,4
Mean	4,2	39,6	13,3	55,9	25,6	78,1	17,0	62,6

The diagram on page 12, represents the figures of the preceding table. The dotted curve shows the yearly mean and the 4 others the different seasons: summer,

autumn, spring and winter. A variation of the climate is, to say the least, not apparent. It is true that, taking together for instance all the tropical countries, a slight eleven years period can be traced out, but it is so small that the investigation, though of great theoretical interest, is of no consequence in practical life.



Shanghai Winters

The winter season is very fine, on account of the dry weather and bracing air, but we only consider here the winter temperature. Beside the mean temperature of the three winter months (p. 11), a new table is offered, showing 1) the absolute minimum of the season, 2) the number of frosty days or, to put it more clearly, of days *with frost*, 3) the number of days when the daily mean was below freezing point, 4) the number of days when the thermometer remained below 0° (32°), 5) the number of hours of frost.

We now take winter in its entirety, from October to April.

WINTER	Minimum		Number of days with			Number of hours of frost
	C.	F.	Minimum below 0°(32°)	Mean below 0°(32°)	Maximum below 0°(32°)	
	°	°				
1872-73	– 7,8	17,8	**89**	8	1	
73-74	– 8,6	16,5	45	12	5	
74-75	– 6,6	20,1	*30*	7	1	
75-76	– 8,2	17,2	88	15	2	
76-77	– 7,1	19,2	49	12	*0*	
77-78	*–11,0*	*12,2*	43	**24**	**6**	
78-79	– 8,2	17,2	46	11	**6**	
79-80	– 7,2	19,0	**80**	11	3	340
80-81	– 9,8	14,4	48	14	2	482
81-82	**–5,4**	**22,3**	*30*	6	*0*	*213*
1882-83	– 9,5	*14,9*	41	19	2	511
83-84	– 8,4	16,9	45	10	2	434
84-85	– 6,5	20,3	**57**	11	1	539
85-86	– 7,8	18,0	56	12	1	566
86-87	**– 4,7**	**23,5**	43	7	2	375
87-88	– 8,2	17,2	33	9	3	322
88-89	– 6,7	19,9	34	13	2	401
89-90	– 5,4	22,3	*29*	*1*	*0*	230
90-91	– 6,1	21,0	40	11	**1**	371
91-92	– 7,2	19,0	47	13	**1**	427
1892-93	*–12,1*	*10,2*	**57**	**25**	**8**	**608**
93-94	– 6,2	20,8	26	4	*0*	204
94-95	– 7,3	18,9	**50**	14	2	591
95-96	– 6,1	21,0	47	11	1	457
96-97	– 7,0	19,4	37	16	6	481
97-98	– 5,6	21,9	38	3	*0*	306
98-99	– 6,0	21,2	44	*1*	*0*	331
99-00	**– 5,3**	**22,5**	*32*	7	1	319
1900-01	– 6,7	19,9	46	12	2	478
01-02	– 5,5	22,1	46	9	1	410
Mean	– 7,5	18,5	47	11	2	408

The number of hours of frost is distributed as follows.

	Maximum	Mean	Minimum	Percentage
November	47 (1880)	10	0 (11 times)	$\frac{1}{72}$
December	190 (1884)	111	2 (1888)	$\frac{1}{2}$
January	266 (1883)	146	39 (1901)	$\frac{1}{3}$
February	314 (1901)	119	18 (1890)	$\frac{1}{16}$
March	95 (1895)	19	0 (3 times)	$\frac{1}{20}$

The last column shows the approximate mean percentage of the hours of frost out of the total number of hours in the months. It is seen that frost always occurs in December, January and February, almost always in the first days of March and pretty often at the end of November. The earliest date when frost was recorded is November 5th, the temperature having fallen to —1°,4 (29°,5) in 1885 and to —0°,3 (31°,5) in 1895; the latest frost took place on March 30th 1901: —1°,0 (30°,2), a very exceptional event. The earliest date when the thermometer did not rise above freezing point for a whole day was December 4th 1891, when the maximum was —0°,7 (30°,7), the latest date when this occured was recorded on February 5th 1884, the maximum having been —1°,0 (30°,2).

January on the whole is the coldest month, and February perhaps a little colder than December.

The winter of 1893 was very severe. Those of 1873, 1882, 1890, 1900, 1902 were relatively mild.

Shanghai Summers

The seasonal means have already been given, p. 11. We now add: 1°) the absolute maximum for each year,

2°) the highest daily mean,

3°) the highest minimum;

4°, 5° and 6°) the number of days in which the thermometer did not fall below 25° (77°,0), 26° (78°,8) and 28° (80°,6) respectively

The absolute maximum occurs generally in July or August, and sometimes in June. In 1876, the hottest day was the 19th of May, when the thermometer reached 35o,7 (96°,3).

	Maximum		Highest Daily mean		Highest minimum		Number of Minima		
	C.	F.	C.	F.	C.	F.	Above 25°	Above 26°	Above 27°
1873	38,0	100,4	31,7	89,1	26,2	79,2	11	1	0
74	36,5	97,7	30,7	87,3	26,2	79,2	16	2	0
75	38,9	102,0	31,0	87,8	27,4	81,3	12	2	0
76	35,7	96,3	29,8	85,6	*25,6*	*78,1*	9	0	0
77	*34,6*	*94,3*	*28,7*	*83,7*	26,9	80,4	14	1	0
78	36,5	97,7	30,5	86,9	27,0	80,6	26	10	0
79	38,7	101,7	31,6	88,9			40	16	0
80	35,6	96,1	30,3	86,5			2	0	0
81	35,8	96,4	30,3	86,5	26,0	78,8	35	9	0
82	*34,6*	*94,3*	29,5	85,1	26,6	79,9	12	2	0
1883	36,3	97,3	30,1	86,2	26,5	79,7	15	3	0
84	35,4	95,7	29,1	84,4	25,9	78,6	8	0	0
85	37,9	100,2	30,4	86,7	26,5	79,7	20	6	0
86	37,0	98,6	30,4	86,7	26,4	79,5	23	5	0
87	38,0	100,4	31,2	88,2	27,2	81,0	22	2	1
88	38,4	101,1	30,2	86,4	26,1	79,0	17	2	0
89	38,0	100,4	31,7	89,1	26,8	80,2	30	8	1
90	37,3	99,1	31,2	88,2	26,4	79,5	8	1	0
91	37,0	98,6	30,4	86,7	26,6	79,9	20	4	0
92	**39,4**	**102,9**	**32,6**	**90,7**	**28,0**	**82,4**	20	7	3
1893	38,0	100,4	30,8	87,4	27,4	81,3	10	3	1
94	**39,4**	102,9	30,8	87,4	26,8	80,2	24	9	0
95	37,9	100,2	31,4	88,5	*27,2*	81,0	11	7	1
96	37,8	100,0	31,2	88,2	*27,2*	81,0	21	9	1
97	38,9	102,0	31,4	88,5	26,6	79,9	26	8	1
98	38,7	101,7	31,3	88,3	27,0	80,6	33	11	1
99	37,4	99,3	29,6	85,3	26,6	79,9	16	1	0
1900	38,0	100,4	31,4	88,5	26,6	79,9	27	10	0
01	36,1	97,0	29,6	85,3	26,3	79,3	13	4	0
02	*32,9*	*93,0*	30,8	87,5	26,5	79,7	15	4	0
Mean	37,3	99,1	30,7	87,2	26,7	80,1	18	5	

The hottest summer was that of 1892, immediately preceding the coldest winter. But the summer of 1894, nearly as warm, was succeded by a moderate winter.

The last columns correspond to hot, oppressive nights, with insufficient fall of the temperature. Here is how they are distributed.

	Above 25°(77°,0)			Above 26°(78°,8)		
	Max.	Mean	Min.	Max.	Mean	Min.
June	3	0	0	1	0	0
July	14	7	2	10	2	0
August	15	6	0	6	2	0
September	3	0	0	0		

The few cases of minima above 27° (80°,6) always occurred in July, except once, August 2nd 1895.

These high temperatures are in reality oppressive only when they take place with SW. winds, but in no wise when the SE. monsoon is blowing. Luckily SW. winds are rare. We append the number of hours during which the breeze blew from SSW., SW., or WSW between 1877 and 1900. See § VI.

	Maximum	Mean	Minimum	Percentage
June	134 (1892)	68	25 (1880)	$\frac{1}{9}$
July	172 (1900)	84	6 (1899)	$\frac{1}{4}$
August	196 (1879)	65	12 (1877)	$\frac{1}{9}$
September	56 (1881)	22	1 (1894)	$\frac{1}{32}$
Summer	416 (1879)	239	105 (1880)	$\frac{1}{12}$

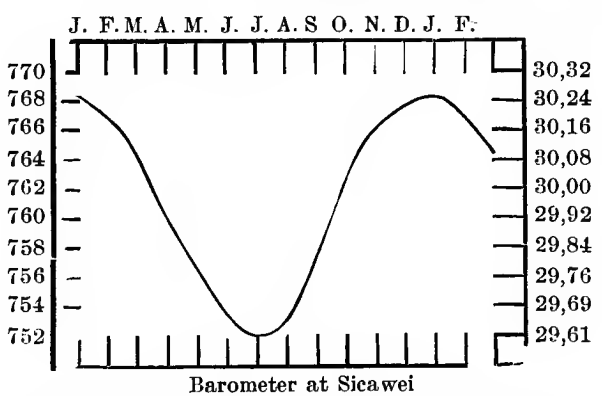
The last column shows the mean percentage of hours of oppressive wind out of the total number of hours.

§II.—BAROMETRIC PRESSURE

The mean barometric reading, reduced to freezing point and sea-level is very different in different parts of the China Coast and in the same place, on various dates. The annual variation in these parts presents one maximum about the middle of January and one minimum in July. The difference between these extremes, at Sicawei, exceeds 16^{mm} ($0^{i},63$). The indications usually inscribed by instrument makers on the dial of the barometer are meaningless. For instance 760^{mm} ($29^{i},9$) would be a very low reading in winter and remarkably high in summer.

Here are the monthly means for Sicawei, at freezing point and sea-level.

	mm	i		mm	i
January.....	**770.3**	**30.33**	July.....	*754,1*	*29,69*
February.....	769,2	30,28	August.....	755,1	29,73
March.....	766,4	30,17	September.....	759,6	29,91
April.....	762,1	30,00	October.....	764,8	30,11
May.....	758,7	29,87	November.....	768,2	30,24
June.....	755,4	29,74	December.....	769,9	30,31
			Mean	762,82	30,03



Barometer at Sicawei

These values are represented on the adjoining curve.

The mean value for each day, at Sicawei, may be had with considerable accuracy from the simple formula.

$$H = 763^{mm} + 8{,}4 \quad \cos.\ (x\text{-}10)$$
$$H = 30^{i}.030 + 0.330 \cos.\ (x\text{-}10)$$

if x is the number of days elapsed since the first of January.

A rapid and considerable departure from the mean generally forebodes bad weather.

Daily variation

The barometric pression undergoes a double oscillation or tide, closely similar to the ocean tide, except that it is principally determined by the Sun, and not by the Moon, as in the case of the sea tide. It consequently occurs at fixed solar hours or nearly so. It is not so apparent or regular here as in lower latitudes, but much more so than farther North. When it fails, it is only on account of a very great change in the pressure. The minima occur about 4 a.m. and 4 p.m. and the maxima about 10 a.m. and 10 p.m., the intervals being 6 hours. The total range may be from 1^{mm} to 2^{mm} ($0^{i}.04$ to $0^{i}.08$).

Irregular variations

These are noticeable on the passage of *electric storms* and cyclones or *whirling storms*.

Thunder-storms

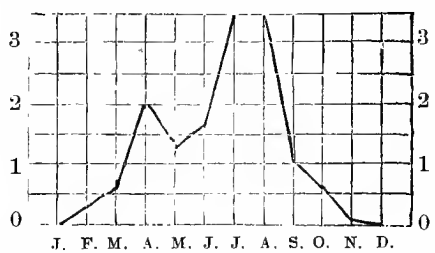
The favourable circumstances for these phenomena are low barometric pressures with a high temperature. A thick, dark cloud is formed, with ugly blueish colouring, frequently surmounted with a white screen of fibrous appearance. From this cloud (cumulo-nimbus) generally fall showers of rain or hail, nearly always accompanied with thunder and ightning.

The system moves simultaneously and sometimes very slowly. In the neighbourhood of Shanghai the direction is generally Eastwards. The passage causes a heavy fall of the glass, which soon rises briskly again.

Electric storms are more frequent in the afternoon, principally in summer.

Total and mean number of thunder-storms observed at Sicawei from 1873 to 1893.

January	*0*	(*0,0*)	July	**70**	(**3,5**)
February	5	(0,3)	August	69	(3,5)
March	12	(0,6)	September	21	(1,1)
April	41	(2,1)	October	11	(0,6)
May	26	(1,3)	November	2	(0,1)
June	34	(1,7)	December	*0*	(*0,0*)



The mean is thus 14 or 15 a year, 13 of which occur from April to September. This scarcity of thunder-storms in winter is a characteristic of continental climates. At Parc S. Maur, for instance, near Paris, thunder is heard in about 28 days a year: but it was heard 7 times only in 20 years, during the 4 winter months, just as here, whilst in June and July there are as an average 5 or 6 stormy days.

At Brest, thunder-storms break out less often than in Paris, but in winter they are more frequent.

In tropical countries, they are much more numerous. In Java for instance, the yearly mean is 167, eleven times

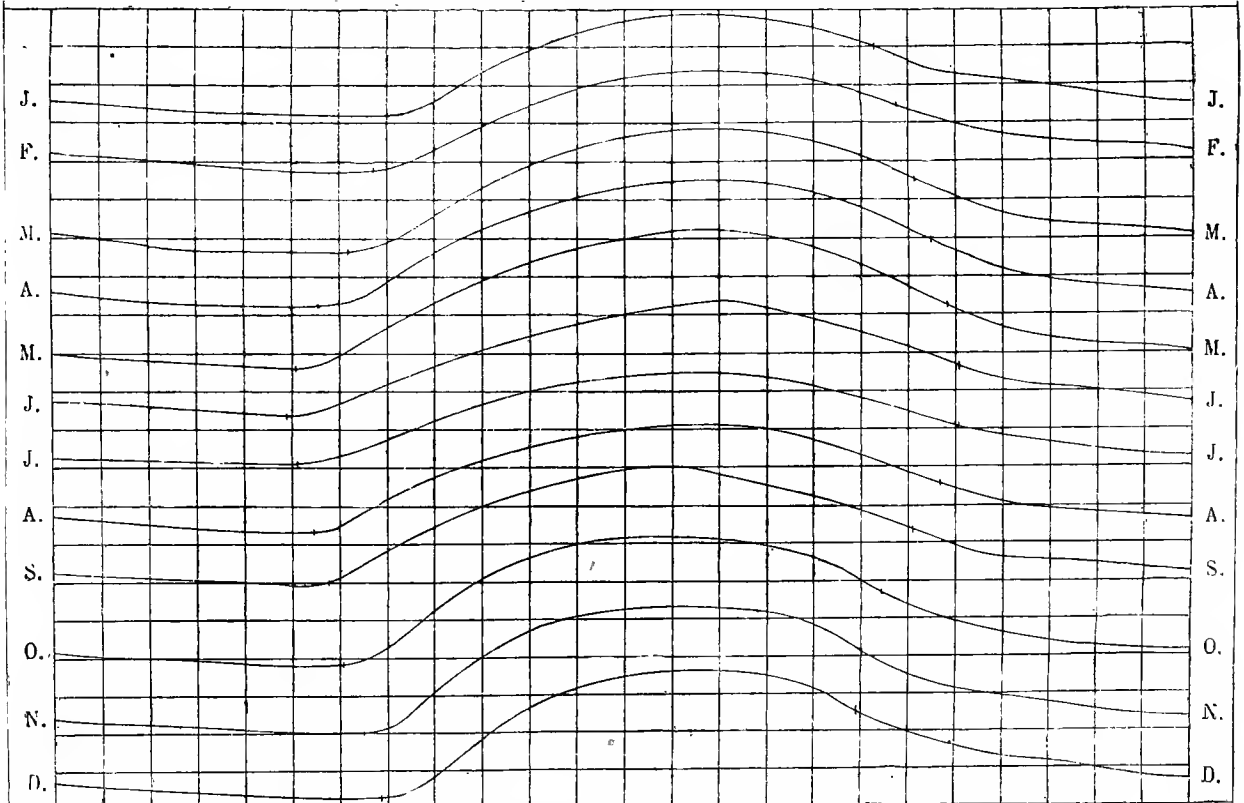
the Shanghai number: scarcely any rain falls except thunderstorm showers and in certain seasons there is a storm almost every evening.

Cyclonic storms

Cyclones or whirling storms offer the following characteristics. The barometric pressure is abnormally low over a more or less restricted area. All around this *depression* or centre, oftentimes rather irregular in form, the winds blow spirally inwards, in anticlockwise direction, that is contrariwise to the movement of the hands of a watch, from right to left, and with a sometimes disastrous violence. In the Southern hemisphere the movement is clockwise. Besides this whirling, the body of the vortex, moves about as a whole, with variable direction and velocity. No general rate can be given for the speed of this movement, as no universal rule concerning the track. The area covered by the storm is sometimes very considerable: the "de Witte" typhoon of 1901 made itself felt at the same time on the 3rd of August at Nagasaki by an E.S.E. gale and at Macao by fresh W.S.W. winds: which shows a diameter of more than 2200 km (1350 nautical miles). But other typhoons may not be 50 nautical miles broad.

Two distinct classes of cyclones are experienced over the seas of China.

1.—*Landstorms.*—Originating in Siberia or Western China, they travel towards the sea, with a marked bend to N.E. After crossing the coast line, they generally gain more strength and may become very violent in reaching Japan or the Sea of Japan. They are principally to be feared in winter, during which season they have a considerable influence over our climate. Their passage is indeed generally followed by a N. or N.W. gale on the Northern part of the



VARIATION DIURNE DE LA TEMPÉRATURE

China Coast, and in the South by a sometimes very severe increase of the N.E. monsoon. Previously to their passing, when the glass is falling, the wind is as a rule not very strong. The velocity of translation of the depression may reach 60 miles an hour, or fall to 8 miles. It averages from 25 to 30.

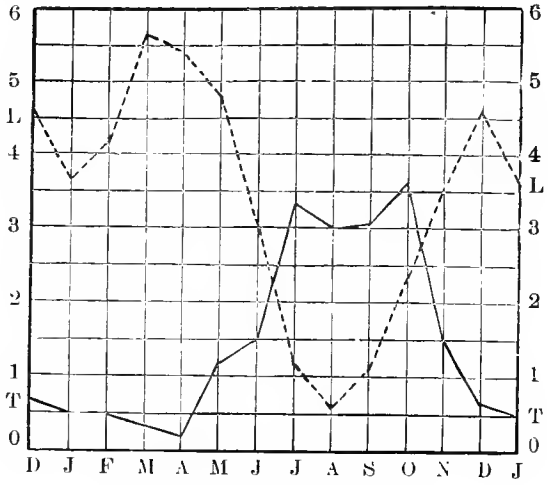
2.—*Typhoons.*—These are formed over the Pacific, South of the 20th. parallel. After travelling to N.W., some of them cross the China Sea towards Indo-China and the Gulf of Tongking, whilst others bend to N. then to N.E. to visit Japan or the China Coast. The velocity is generally low whilst recurving, but increases rapidly when they move away from our neighbourhood. The typhoon of September 8th 1897 from instance, travelled at the rate first of 10 miles an hour, then reached successively 27, 33, 37, 47 and 52. These two last figures are abnormal.

Typhoons scarcely approach Shanghai except from July to September. They are ushered in by a fall of the glass with N.E. winds.

The following table shows the mean number of typhoons (T) which have been observed in 13 years, and that of landstorms or continental depressions (L), observed during 10 years over that part of Eastern Asia, which is covered by the meteorological system of the Sicawei Observatory. In the diagram the full line refers to the typhoons. The opposition of the two curves is very remarkable.

	T.	L.		T.	L.		T.	L.
January...	0,5	3,7	May.....	1,2	4,8	September	3,1	1,1
February..	0,5	4,2	June.....	1,5	3,0	October....	**3,6**	2,3
March.....	0,3	5,7	July.....	3,3	1,2	November.	1,5	3,6
April.....	0,2	**5,4**	August.....	3,0	0,6	December..	0,7	4,6

A figure like 1,5 means "one or two yearly" or "three in two years."



Typhoons and Landstorms

§III.—HYGROMETRY

Relative humidity is the percentage of the actual vapour pressure to that of saturated water vapour at the temperature of the air, or the proportion between the actual pressure of watery vapour and that which would exist, were complete saturation reached, at the same temperature.

Relative humidity at Sicawei

(1873-1902)

	Monthly Mean			Mean at Marseilles		Monthly Mean			Mean at Marseilles
	Max.	Average	Min.			Max.	Average	Min.	
January	89	79	73	69	September	89	79	69	63
February	87	78	67	65	October	85	77	69	68
March	87	77	65	62	November	84	*76*	66	**70**
April	88	77	64	61	December	84	*76*	63	**70**
May	84	77	62	59					
June	89	**80**	*61*	57	Yearly Mean				
July	**90**	**80**	64	55	Year	83	78	69	63
August	89	**80**	69	57	Range	—	4	—	15

The annual variation, at Sicawei, is insignificant, there being only a slight maximum during the summer monsoon. At Marseilles the mean is much lower and the range nearly 4 times greater.

The diurnal variation is on the contrary rather important. The hygrometric state is very high at sunrise, falls rapidly as soon as the grouud grows warmer and rises again after the temperature has attained its maximum.

Percentage of aqueous vapour

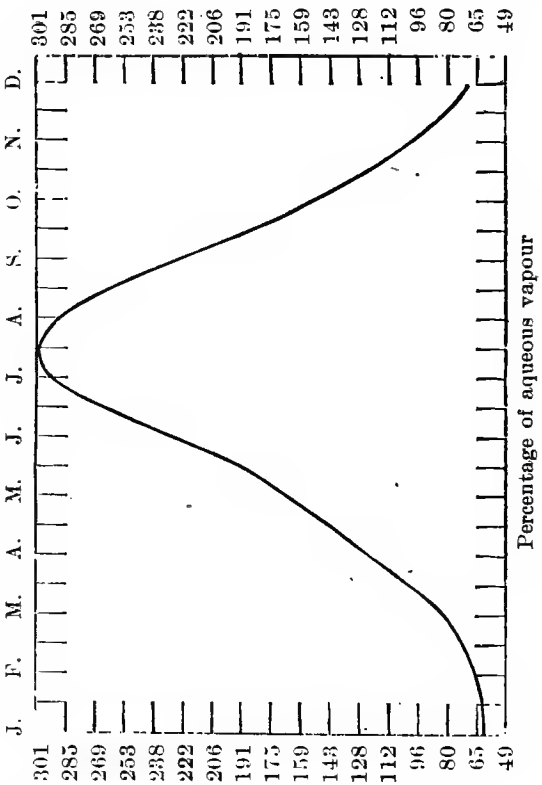
It is interesting to know the ratio which the weight of watery vapour bears to the weight of dry air, as this gives the amount of vapour contained in the atmosphere without reference to the temperature. This amount is always very small : we therefore give the figures multiplied by 100,000.

Annual variation of vapour

(1873-1902)

	Maximum	Mean	Minimum
January	757	*607*	458
February	775	647	*423*
March	1042	840	700
April	1456	1239	1048
May	1891	1699	1467
June	2805	2348	2046
July	3245	**3011**	2641
August	**3340**	2982	2607
September	2726	2270	1951
October	1875	1564	1201
November	1292	1038	774
December	934	705	519
	Mean of the year		
Year	1690	1579	1454

As will be seen by this table and the annexed diagram, the amount of watery vapour varies considerably with the seasons. It attains its minimum in January, then increases



steadily until the end of July, and falls again during the remainder of the year. So that the amount of vapour in summer, when the S.E. monsoon is blowing from the Pacific, is almost exactly 5 times what it is in winter, when the winds from Siberia and Mongolia prevail.

The daily variation is comparatively unimportant, and depends on the season. During the winter monsoon, the amount of vapour is small and presents a double daily tide of no great amplitude; maximum between 9 and 10 a.m. and about 7 p.m; minimum about 6 a.m. and 2 p.m.—During the summer monsoon, the vapour is copious and undergoes only one undulation but better marked. Relatively lower in the morning, it increases rapidly about sunrise until 1 p.m., then decreases until the next morning.

During the intermediate months, the curve progressively changes from one type to the other.

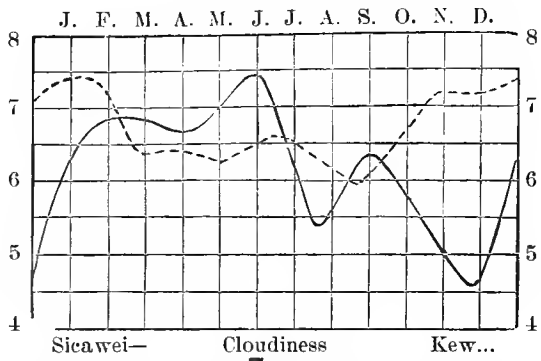
§IV.—CLOUDINESS

This feature is very changeable. We give here the result of three-hourly observations made from 4 a.m. to 9 p.m. at Sicawei from 1873 to 1901: 0 means a cloudless sky, 10 indicates that it is completely overcast.

Juxtaposed are the means obtained at Kew (London) for 21 years. It will be noticed how completely different the two curves are. In Shanghai, cloudless days are to be expected in November and December, while June is the month of the greatest cloudiness.

The amount of clouds is generally a little greater in the middle of the day.

	Max.	Mean	Min.	Kew		Max.	Mean	Min.	Kew
January.....	9,1	6,3	2,4	**7,4**	September...	8,2	6,3	3,9	*6,1*
February....	9.3	6,8	4,2	7,2	October.....	9,0	5.8	3,7	6,7
March.....	**9,4**	6,8	5,1	6,4	November...	8,4	5,1	*2,3*	7,2
April.....	8,0	6,7	3,6	6,4	December....	8,0	*4,7*	2,7	7,2
May.....	8,7	7,0	5,5	6,3					
June.....	9,0	**7,4**	5,6	6,5	Yearly Mean				
July.....	8,6	6,2	3,9	6,5					
August.....	8,6	5,6	3,3	6,2	Year.....	7,2	6.2	5,5	6,7



Fog

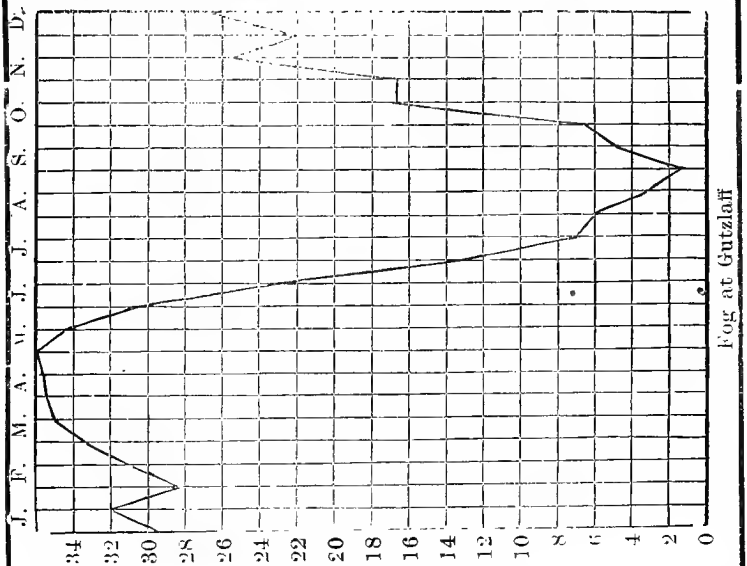
Fog is but a cloud in contact with the ground. It consists in minute water drops, which by their great number render the air more or less opaque.

Fog occurs more frequently in the early morning (3 a.m. to 7 a.m.,) and more rarely from 9 a.m. to 5 p.m. than at other times of the day. At the mouth of the Yang-tse-kiang, fog is common in spring, and quite exceptional in autumn: the same fact is verified along the coast, to the South of the Formosa Channel. On the North Coast, the maximum takes place in July and the minimum from August to November.

We here give, for every fortnight, the probability of encountering fog at Gutzlaff. The figures are multiplied by 100. The observations range over 20 years.

Fog at Gutzlaff

January....	8	94	May.....	8	330	September.	5	4
	23	140		23	300		20	6
February...	7	106	June.....	7	290	October.....	5	10
	22	194		22	230		20	26
March.....	9	194	July.....	7	130	November..	4	50
	24	296		22	54		19	76
April.....	8	310	August.....	6	16	December...	4	40
	23	**346**		21	0		19	64



§V.—RAINFALL

1.—*Rainy days.* We consider as rainy any day during which there is a fall of $0^{mm},1$ (0^{i},004) or more of rain, snow, hail, &c. Quite a number of fine days are therefore recorded as rainy, or to put it more clearly as *days with rain.*

Number of days with rain

	SICAWEI (1873-1902)			Marseilles. Mean	Peking Mean	Hongkong Mean
	Max.	Mean	Min.			
January	19	10	2	10	2	8
February	19	10	0	8	3	11
March	22	13	5	9	4	12
April	22	13	6	10	4	14
May	21	13	8	9	7	17
June	21	**14**	7	6	11	**22**
July	22	11	3	4	**14**	21
August	21	11	4	5	11	17
September	17	12	2	7	8	13
October	**24**	10	2	10	3	9
November	18	8	2	10	3	5
December	14	7	2	9	2	5
Year	167	131	97	96	72	154

2.—*Amount of rainfall.*—This is measured by the height of the water fallen, and which has not evaporated or *percolated* (filtered) into the ground. The rain is received in a rain-gauge, a very simple instrument, which should be set in an open place remote from trees, walls and buildings, so as to avoid wind eddies. The top of the rim should be about 1^{m} above the ground; in England one foot is the usual height. Of all the meteorological observations, the determination of rainfall is the easiest and that which perhaps would prove the most useful in China.

Amount of rainfall

	SICAWEI (1873-1902)						Hongkong Mean	
	Maximum		Mean		Minimum			
	mm	i	mm	i	mm	i	mm	i
January.	197,3	7,77	54,5	2,15	0,7	0,03	33,55	1,32
February	107,9	4,25	58,1	2,29	*0,0*	*0,00*	49,45	1,95
March.....	152,4	6,00	81,6	3,21	15,1	0,59	66,78	2,63
April.....	239,5	9,43	90,7	3,57	23,4	0,92	142,48	5,61
May.....	182,1	7,17	91,4	3,60	28,3	1,11	342,76	13,50
June.....	**491,9**	**19,37**	**169,1**	**6,66**	18,8	0,74	**414,24**	16,31
July.....	295,5	11,63	129,6	5,10	3,0	0,12	340,22	13,40
August...	343,3	13,52	150,8	5,94	12,4	0,49	360,34	14,19
Sept.....	274,1	10,79	119,8	4,72	19,8	0,78	196,88	7,75
October..	304,2	11,97	81,4	3,31	7,9	0,31	124,10	4,89
Nov.....	150,6	5,93	47,0	1,85	2,5	0.10	44,27	1,74
December	92,4	3,64	*30,0*	*1,18*	3,6	0.14	*27.43*	*1,08*
YEAR	1588,1	62,53	1107.5	43,60	709,2	27,92	2142,50	84,35

3.—*Intensity of rain.* This is the ratio of the quantity fallen with the number of *days with rain*. It is very important, as a short and violent shower or a thin rain lasting hours have very different effects.

Mean intensity of rain

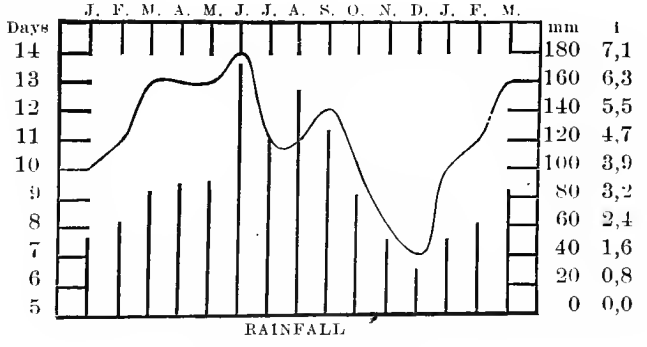
January.....	5,5	May.....	7,0	September.....	10,9
February.....	5,8	June.....	12,1	October.....	8,1
March.....	6,3	July.....	11,8	November.....	5,9
April.....	7,0	August.....	**13,7**	December.....	*4,3*

The variableness of rain is extreme. The same month, October for instance, may have 2 or 24 rainy days, and the amount of rain fallen may range from 7^{mm}, 9 ($0^{i}.31$) to 304^{mm}, 2($11^{i}.97$) *i.e.* nearly 39 times as much. For the whole year, days with rain range from 97 in 1873 to 167 in 1882, and the amount of rain from 709^{mm} ($27^{i}.9$) in 1892 to 1588^{mm} ($62^{i}.5$) : these figures are in the ratio of 1 to 2. Consequently the means cannot convey a very clear notion, as in the case for instance of temperature. The diagram shows however a neat annual curve, which bears a strong likeness to the cloudiness trace, even in its smallest details.

June is pre-eminently the rainy month, both for frequency and abundance. In June 1875, there was a rainfall of 491^{mm}, 9 ($19^{i}.37$) in 21 days ; it is the maximum.

August is noteworthy for its heavy showers.

December is the dry month, atmospheric precipitation being rare and small. There are always at least 17, and often 28 or 29 days without a drop of rain. But even in June, more than half of the days and at least 7 are without rain.



In the diagram, the full line shows the number of days with rain, the vertical strokes are proportional t › the amount of rainfall. This type of curve, with one maximum in summer and one minimum in winter is typical of the continental system. It prevails all along the China coast, but with notable differences. In Hongkoug the total quantity is nearly twice that in Shanghai, whilst in Peking it is only one half. In these two stations, mostly in the North, the prevalence of summer rains is more strongly marked than here. The following table gives in thousandths, the ratio of the rainfall of each month to the total rainfall of the year. At Peking v.g. in January, the average amount of rain is $\frac{3}{1000}$ of the total rainfall, which is 664^{mm} ($26^{i}.142$).

Thousandths of total rainfall

	Peking	Sicawei	Hongkong
January	3	49	15
February	4	52	23
March	8	74	31
April	27	82	66
May	45	83	159
June	96	**162**	**193**
July	**394**	117	159
August	274	136	173
September	104	108	92
October	29	73	58
November	14	42	21
December	2	27	13
Total rainfall	664mm(26i.142)	1108mm(43i.602)	2143mm(84i 371)

The rainfall during the wet month is 6 times that of December in Shanghai, whilst the ratio is 15 times in Hongkong and 197 in Peking : the balance of the season is thus much more equal here. Indeed in Hongkong, there are at least 18 rainy days in June and sometimes as many as 26 ; showers are also heavier. On May 29th and 30th 1889, there was a downpour of 886^{mm} ($3^{i},488$) in 36 hours. During winter the frequency and abundance of rain are not much less than here.

Rainy and dry years seem to succeed each other without any order: neither does any compensation seem to take place. If we divide our 30 years, into 6 equal periods, we find widely different totals.

		mm	i			mm	i
1873-77	739 day	5328	209,77	1888-92	690 day	5450	214,57
1878-82	682 ,,	6250	246,07	1893-97	661 ,,	6086	239,61
1883-87	651 ,,	5698	224,34	1898-1902	636 ,,	5419	213,35

Snowfall

Snowfalls are not entered separately from rain, as they are of comparatively too rare occurrence. We here append the number of *days with snow* observed at Sicawei, since December 1872. Even a few flakes mixed with rain are taken into account.

Days with snow (1873-1902)

	Maximum	Mean	Minimum
November	1 (6 times)	0,2	0 (24 times)
December	4 (1882)	0,6	0 (17 times)
January	8 (1893)	2,8	0 (5 times)
February	5 (thrice)	1,9	0 (6 times)
March	5 (twice)	0,7	0 (19 times)
April	1 (1882)	0,0	0 (30 times)
WINTER	13 (1893)	6,0	1 (1873)

The earliest recorded snowfall took place on November 11th 1885 and the latest on April 4th 1882.

The maximun quantity fallen was 22^{cm} ($8^{i}.66$) on January 29th 1893.

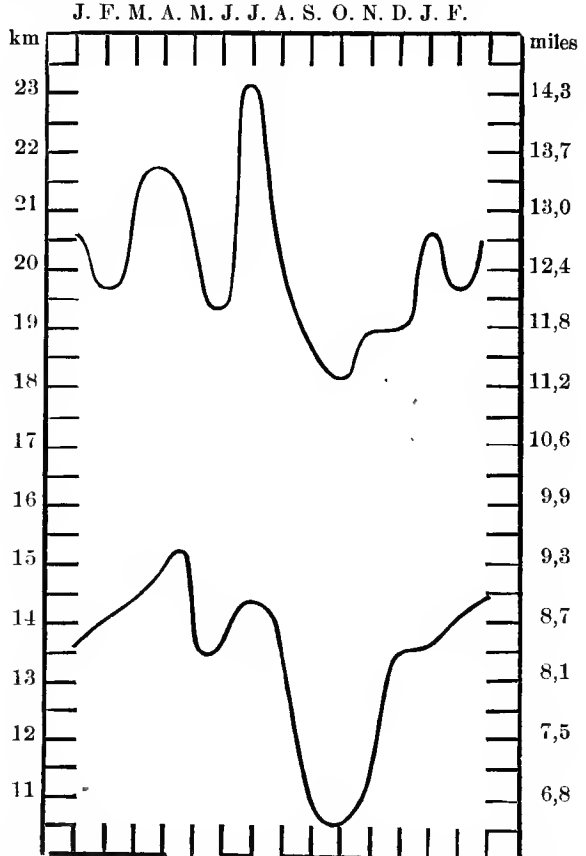
§VI.—WIND

Force

The *diurnal variation* is very marked in Shanghai. The breeze is light at night, increases shortly after sunrise, remains steady from 10 or 11 a.m. to 3 or 4 p.m. and then abates rapidly until night.

As to the *annual variation*, the mean force of the wind increases from October to April, then falls considerably until June, rises very briskly in July, and abates again until October.

We here give in kilometers and miles per hour, the windforce for each month, as registered on the Observatory tower at a height of 40^{m} (130 feet) for 12 years and of 12^{m} (40 feet) for 16 years.



Force of the wind at 40^{m} and 12^{m} (kil. and miles per hour)

	40m		12m			40m		12m	
	km	miles	km	miles		km	miles	km	miles
Jan.....	20,4	12,7	13,6	8,4	July.....	**22,1**	**13,7**	**14,3**	**8,9**
Feb.....	20,5	12,7	14,1	8,7	August	20,7	12,9	13,6	8,4
March..	21,3	13,2	14,4	8,9	Sept.....	18,8	11,7	11,1	6,9
April....	**21,4**	**13,9**	**15,0**	**9,3**	Oct.....	*18,0*	*11,2*	*10,5*	*6,5*
May.....	20,5	12,7	14,1	8,7	Nov.....	18,5	11,5	11,4	7,1
June....	*19,1*	*11,8*	*13,7*	*8,5*	Dec.....	19,6	12,2	13,6	8,4

The annual means are 20^{km}, 1 (12 miles, 5) and 13^{km}, 3 (8 miles, 2).

Direction

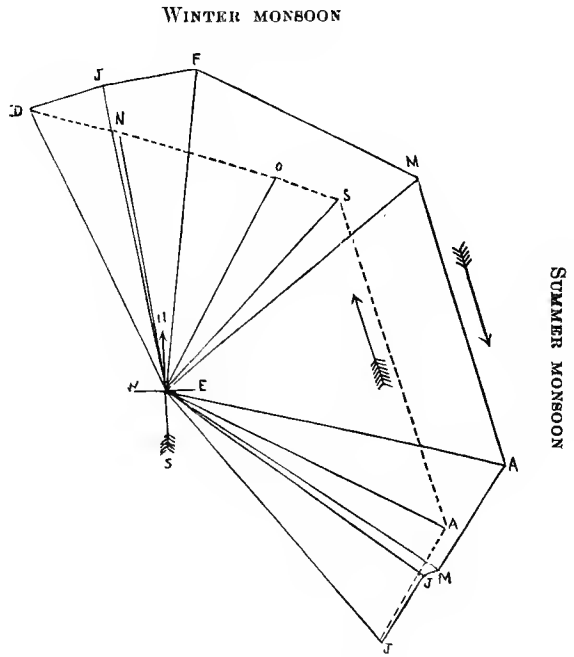
Though the *diurnal variation* is less apparent than that of force, still the main features are known with sufficient certainty.

During the winter monsoon, September-March, the wind tends to blow from W. in the morning, then from N., and from E., in the evening, as if there was a summons of the air towards the Sun. From 6 p.m. to 6 a.m. the breeze backs to W.

During the summer monsoon, June, July and August, the general direction is S.E., but there is twice a day a marked tendency to blow from the S., about 10 a.m. and after sunset.

Annual variation. We here give the mean direction of the wind at Sicawei for each month; the figures which refer to the summer monsoon are printed in italics.

Jan..	N 9° W	April	*S 76° E*	July.	*S 39° E*	Oct...	N 31° E
Feb..	N 8° E	May..	*S 55° E*	Aug..	*S 62° E*	Nov..	N 8° W
Mar..	N 52° E	June.	*S 58° E*	Sept.	N 45° E	Dec...	N 23° W



DIRECTION OF THE WIND

The mouth of the Yang-tse is thus clearly subject to the *monsoon regime*.

In the diagram, the direction of the lines from the middle of the wind arrow shows the resultant direction of the wind for each month. The distance of the points from the same centre is proportional, not to the force of the resultant (which may be very small) but to the sum total of the wind for the month. Suppose we have 30 miles of N. wind and 40 miles of E. wind, the resultant will be 50 miles of N. 37° E., but the aggregate will be 70 miles. The wind is *veering* slowly from December to July, then *backing* during the rest of the year.

Monsoons in China

Monsoons are periodical winds of considerable steadiness during several months. In China and the adjoining seas, there are the summer and winter monsoons.

The summer monsoon is caused by the high temperature and low atmospheric pression which prevail over the continent. The wind rushes from sea to land, but is deviated *to the right*, on account of the rotary motion of the earth. So that it turns, almost anticlockwise, as in the case of cyclones around the China Coast, blowing,

from S. or S.W. in Kwantung,
from S.W. in the Formosa Channel,
from S.E. at Shanghai,
from S.W. in Shantung.

The monsoon sets in progressively: the change beginning in March or April in the North, and in May in the Formosa Channel. In June the summer system prevails along the whole coast. In Shanghai, it lasts from April to August, *i.e.* about 4 months.

The winter monsoon is caused by the low temperature and high pressure prevalent in Asia. Winds blow from land to sea, always deviating *to the right*, and so form an anticyclonic or clockwise system. The direction is

N. in Shantung,
N.W. at Shanghai,
N.E. in the Formosa Channel,
E. at Hongkong.

Contrary to what happens in India, the winter monsoon is the steadier, at least in the Formosa Channel. A N.E. gale may be said to blow with short interruptions at the Pescadores, during the whole season. The same may be said of the strait of Tartary, putting N. for N.E.

The winter monsoon sets in in the first half of September or even at the end of August. In Shanghai it lasts nearly 7 months.

§VII.—OZONE

Ozone is an exceptionally active condition of oxygen. It is found in small quantities in the atmosphere, where it has a beneficial effect. There is little or no ozone in towns and in houses.

There is a slight maximum at night, and a minimum in the middle of the day.

The yearly variation at Sicawei after 26 years of observation, shows a maximum in the last decade of February and a minimum at the end of August. The monthly means are as follows.

January.....	10,6	May.....	11,0	September.....	8,3
February.....	11,4	June.....	9,9	October.....	9,2
March.....	**11,9**	July.....	7,0	November.....	9,8
April.....	11,7	August.....	6,6	December.....	10,1

These figures are according to an arbitrary scale ranging from 0 to 20.

§VIII.—HEALTH

It is not within our sphere to treat of health or hygiene. Moreover, the foreign population of Shanghai underwent since half a century too many changes to base thereon trustworthy statistics.

It will be enough to give here:

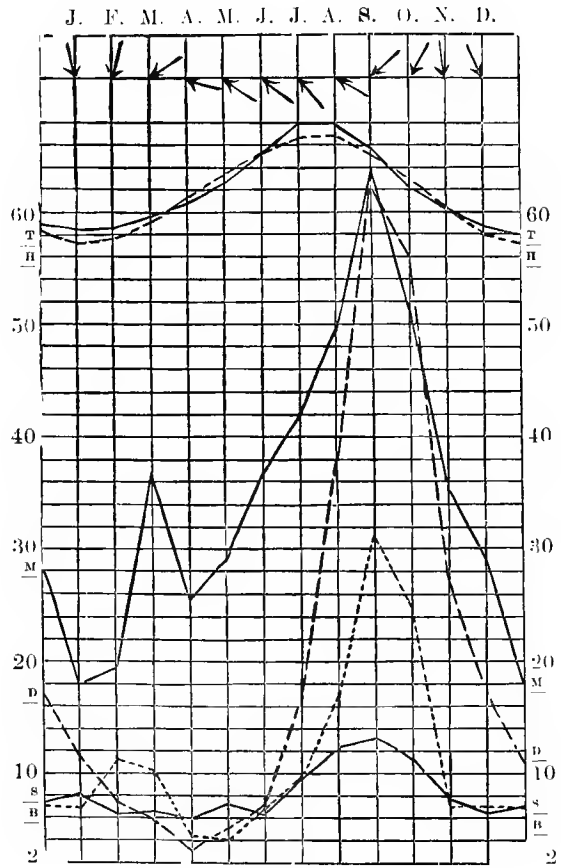
1) the mean number of burials (S) for each month, during 33 years (October 1871-September 1894). Chinese alone are not included. The figures are borrowed from the Medical Reports of the Imperial Maritime Customs.

2) and 3) the mean number of cases of dysentery (D) and malaria (M) which were reported to the Medical Service of the Foreign Settlement, during the 3 years 1899, 1900 and 1901. The figures are from the Annual Reports of Dr. A. Stanley. 4) the mean number of cases (Chinese) of beri-beri (B), admitted into the Municipal Isolation Hospital, during the same 3 years. Our authority is the very interesting study of this disease by Dr. A. Stanley in his Annual Reports

	S.	D.	M.	B.
January	8,1	11,7	*18,0*	7.0
February	6.3	7,7	19,7	11,3
March	6,6	6,0	36,7	10,3
April	*6,0*	*3,3*	25,7	4,3
May	7,3	5,0	29,3	*4,0*
June	6,3	7,3	37,0	6,7
July	9.6	16,7	42,0	8,7
August	12,3	38,0	51,7	16,7
September	**13,4**	**64,3**	**65,3**	**31,7**
October	11,5	58,0	53,3	25,0
November	7,9	27,3	35,3	7,3
December	7.4	17,3	29,3	7,3

These figures are represented in the diagram. The curve of temperature (T) and humidity (H), and finally the mean wind directions are added for comparison.

A glance at these curves shows clearly that during the S.E. monsoon the climate of Shanghai is *subtropical*, whilst for the remainder of the year it is *temperate*.



Health

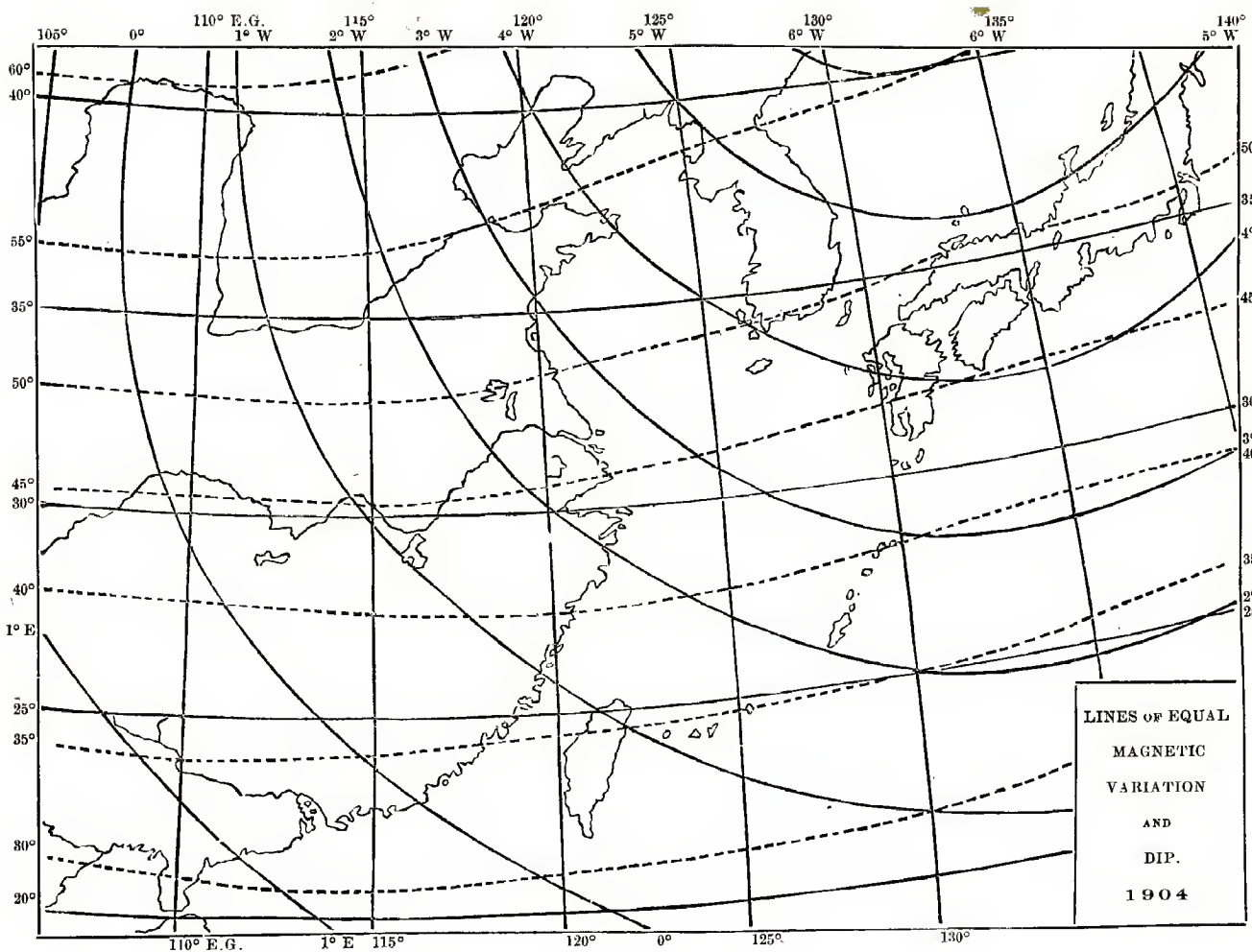
Addendum

Mean magnetic values at Shanghai, in 1902

Declination	2° 25' West
Mean Secular change	+ 1'
Mean Daily oscillation	4',7
Daily minimum about 2 hours after sunrise	
Daily maximum	1 p.m.
Dip	45° 40'
Total force	0,4714 C.G.S.
Horizontal force	0,3294 C.G.S.
Vertical force	0,3391 C.G.S.

We append a chart of the lines of equal magnetic variation — and equal dip ..... for 1904.

INDEX


105°
0°
110° E.G.
1° W
115°
2° W
3° W
120°
4° W
125°
5° W
130°
6° W
135°
6° W
140°
5° W
60°
40°
55°
35°
50°
45°
30°
40°
1° E
25°
35°
30°
20°
50°
35°
4° W
45°
30°
3° W
40°
35°
2° W
25°
110° E.G.
1° E
115°
120°
0°
125°
130°
LINES OF EQUAL
MAGNETIC
VARIATION
AND
DIP.
1904